Silver Lake Sub-Watershed Implementation Strategy

For the Silver Lake Commission

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INTRODUCTION

The St. Jones River is located in Kent County, Delaware and hosts the state capital, the City of Dover. The City of Dover has a large influence on the St. Jones River, its tributaries, and the entire Watershed of which it drains. Silver Lake, a man-made lake formed by a dam in the St. Jones River, is the largest body of water in the City, and has attracted residents and visitors to enjoy its benefits. The growing number of visitors and increasing development of land have taken their toll on the Lake. In 1986, the Silver Lake Commission (Commission) was formed following the recommendation of Dover's City Council. On August 27, 1990, by request from then-Mayor Jack Richter, the Commission was officially adopted as an advisory committee to the City Council and City staff.

Since then, the Commission has worked to improve the condition of the Lake and provide a forum for public involvement on issues related to the Lake. Commission members seek ways to improve the Lake's water quality, wildlife habitat, open space and park opportunities, and water-related activities through participation and coordination with other government bodies and institutions (Dover, 1990).

The purpose of this document is to provide the Silver Lake Commission and its partners with a strategy for implementing water quality-improvement projects that influence the ecological condition of Silver Lake. A prioritized list of potential Best Management Practice (BMP) opportunities with the greatest cost-benefit ratio to Silver Lake shall serve as a resource to the Commission for future project planning.

In addition to this document, other resources are available for planning goals outside of this document's reach, such as wildlife habitat improvement, open space creation, or recreational activity implementation.

SAINT JONES RIVER HISTORY

The St. Jones River is dammed at Silver Lake and winds down 10mi towards the Delaware Bay passing through commercial, residential, and agricultural areas along the way. The watershed of the St. Jones River drains the upland area of the River in addition to its tributaries including Fork Branch, Maidstone Branch, Cahoon Branch, McKee Run, and Dover Creek. 57,643 acres of land drain into the St. Jones River, ultimately emptying into the Delaware Bay (Rogerson, Jacobs, & Howard, 2010).

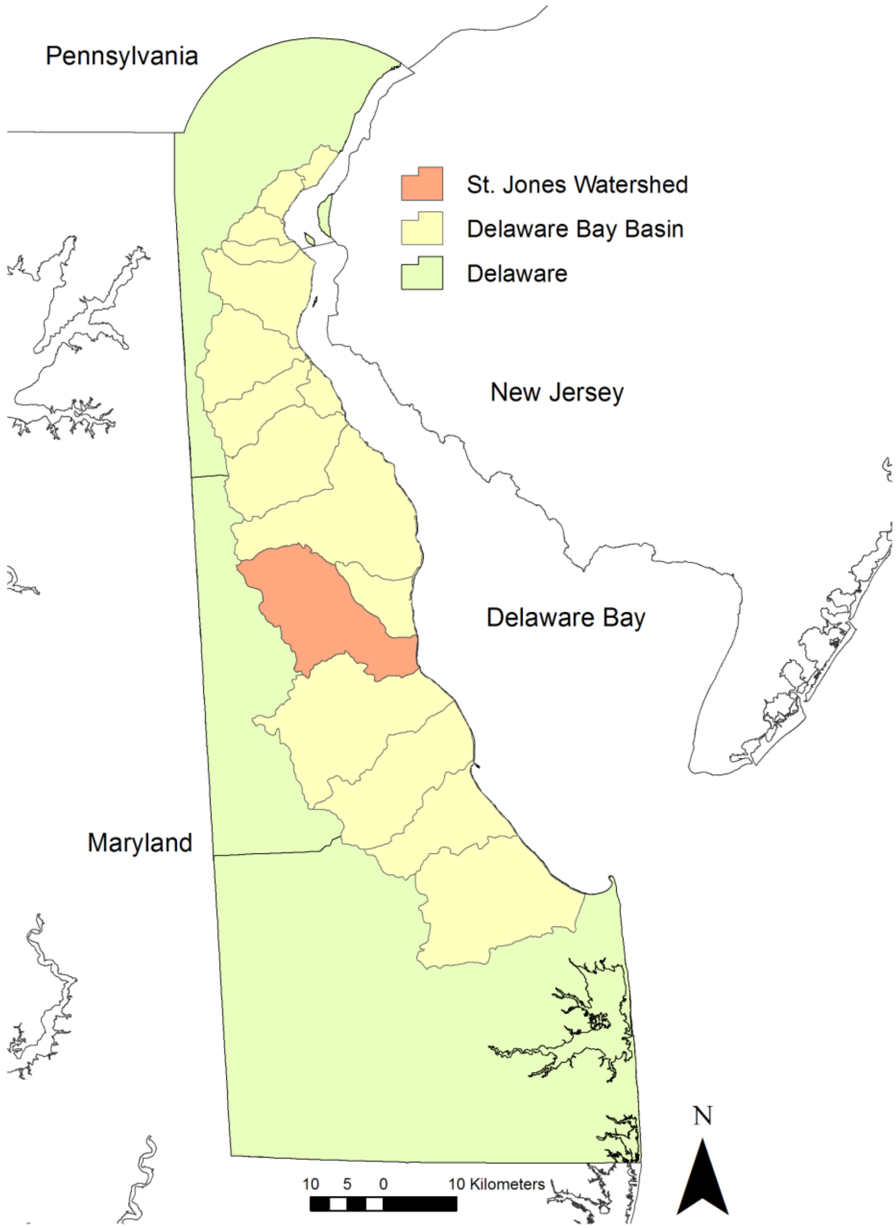


Figure 1. Location of the St. Jones River Watershed in central Delaware.

Land use activities can characterize a particular region, such as a watershed, and provide a snapshot of the area showing how it is being used. Comparisons between land use data from different points in time provide insight into how the landscape has changed and what trends have started to appear. Land use data allows planners and land managers to make informed decisions regarding the future development and protection of a watershed.

Historically, the watershed land use characteristics were dominated by agriculture. In today's landscape, while agriculture is still a dominant land use, it is quickly being replaced by development, more specifically, residential development. The National Land Cover Dataset (NLCD) in 2007 shows almost 70% of the watershed as agricultural or developed land. Information from the NLCD in 1997 compared to 2007 shows a 6.5% decrease in farmed land and a 6% increase in developed land (Table 1). This suggests an almost direct conversion of farmland to developed land. As stated in the "Technical Background Report, Silver Lake Watershed" by Earl Shaffer, "urbanization through the conversion of land to permanent impervious surfaces such as streets and houses, represents an irreversible impact on the watershed" (Shaffer, 1989). Proper planning is necessary to prevent costs associated with clean-up efforts downstream of development; it is also necessary to protect ecologically important areas that play an integral part in the health of the watershed.

A more detailed description of the history of the St. Jones River and watershed can be found in the DNREC report "Technical Background Report, Silver Lake Watershed."

Table 1. Land use changes for the St. Jones River watershed between 1997 and 2007 (Rogerson, Jacobs, & Howard, 2010)**.**

Land Use Category	**1997 (%)**	**2007 (%)**	**10-year % Change**
Developed	25.5	31.5	+6.0
Recreational	1.4	1.8	+0.4
Farmed	44.5	38.0	-6.5
Forest	9.8	8.4	-1.4
Wetlands	14.9	15.1	+0.2
Water	2.1	2.7	+0.6
Beaches/Sand	<1.0	<1.0	0
Extraction or Transitional	1.8	2.4	+0.6

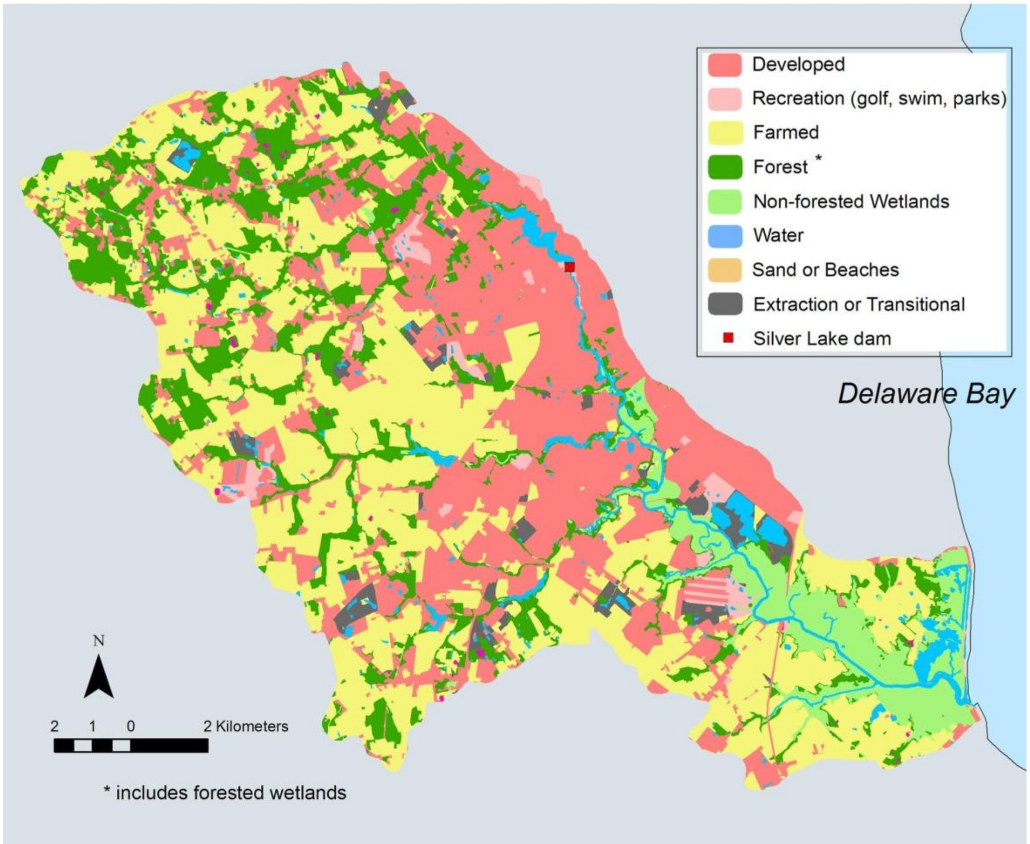


Figure 2. Land Use in the St. Jones Watershed in 2007 based on NLCD land use categories.

EXISTING WATERSHED CONDITIONS

Under the Federal Clean Water Act, the State's Department of Natural Resources and Environmental Control (DNREC) has the responsibility of monitoring the water quality in the St. Jones Watershed and other watersheds in Delaware. DNREC analyzes water samples for impairments that could compromise the integrity of the waterways and the many uses they provide. Impaired waterways that do not meet the specified State and Federal standards are listed on the national 303 (d) list. If a waterway is on the list, under the Federal Clean Water Act, DNREC is required to develop a Total Maximum Daily Load (TMDL) to remediate the water quality of the watershed. A TMDL was developed for the St. Jones Watershed to address the impairments found in all of the Watershed segments.

The State of Delaware's 2010 Combined Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs identifies 8 listed water segments: 2 tidal segments of the St. Jones River, 3 freshwater stream segments, and 3 freshwater lakes or ponds. Reasons for listing include bacteria, dissolved oxygen (DO), PCBs, nutrients, dioxin, mercury, DDT, arsenic, biology, and habitat (DNREC, April 2010). The most probable source of these pollutants is from Non-Point Source (NPS) pollution. TMDLs are currently in place to reduce pollutants and eventually remove water segments off the impairment list (303(d)). TMDLs should be used as a guide for prioritizing water quality improvement projects and incorporated into future land planning and management decisions.

WATERSHED BASELINE ASSESSMENT

A baseline assessment of the entire St. Jones Watershed (Watershed) was completed by Duffield Associates, Inc. (Duffield) in October 2008. With help from volunteers, Duffield identified and evaluated potential pollution control opportunities in the sub-watersheds and urban areas that would improve water quality and prevent impairment. In total, 158 opportunities were identified, scored, and prioritized, including 26 WMWQ technology opportunities and 132 upland opportunities. An additional five potential corridors for preservation/land management opportunities were also identified.

The baseline assessment indicated various sources and types of water quality impairment. Duffield then identified several practices that could reduce pollution in the Watershed and selected sites to evaluate the practices. "Upland target areas included opportunities such as retrofitting existing sites with revised best management practices (e.g. bioswales, bioretention) and select neighborhood and hotspot sites that could increase water quality protection by using different site or land management practices. The upland sites were ranked from high to low priority. The WMWQ sites were evaluated for six technologies, which focused on wetland/floodplain restoration and creation, buffers, infiltration, and preservation. The WMWQ sites were scored and then ranked by Watershed-wide, sub-watershed, technology, and site. Table 5 shows Watershed-wide rankings for total WMWQ scores and individual WMWQ technology scores for each site evaluated" (Duffield Associates, Inc., October 2008). (Christina Tributary Action Team and Water Resources Agency, 2007; F.X. Browne, 1988; DNREC, City of Dover, and Advisory Committee, 1996)

Projections for future impervious cover are increasing in all four sub-watersheds (Table 2). The Silver Lake sub-watershed is projected to have the greatest amount of total area of imperviousness (5,122.4 acres), while the Tidbury Creek sub-watershed is projected to have the greatest increase of imperviousness relative to total land area (27.6%).

Table 2. Sub-Watershed Potential Future Land Use Statistics and Existing Protected Lands

	SUB-WATERSHED			
	St. Jones	Tidbury Creek	Issac Branch	Silver Lake
Current Impervious (acres)	1,616.9 (9.8%)	660.5 (10.4%)	922.4 (10.2%)	3,868.0(15.7%)
Designated Open Space (Protected Lands in acres)	5,236.2 (31.6%)	349 (5.5%)	1,144.5 (12.6%)	878.7 (3.6%)
Future Impervious Cover (acres)	3,874.3 (23.3%)	1,752.8 (27.6%)	1,987.7 (22.0%)	5,122.4 (20.8%)

SUB-WATERSHED DELINEATION

For the purposes of this report, the four sub-watersheds identified by the Duffield Report (Duffield Associates, Inc., October 2008) will be used and referenced throughout this strategy.

The Duffield report created a map that delineates the sub-watersheds of the St. Jones Watershed based on existing geospatial data (Figure 3). The sub-watershed delineation map is used to more accurately report data and recommendations in each sub-watershed. The sub-watershed boundaries reported by Duffield are as consistent as possible with those reported by DNREC. The sub-watersheds include: Isaac Branch, Silver Lake, St. Jones River, and Tidbury Creek.

Water bodies within each sub-watershed include:

Silver Lake-	Fork Branch, Penrose Branch, Maidstone Branch, Cahoon Branch, Puncheon Run, Upper St. Jones River, Silver Lake
Isaac Branch-	Isaac Branch, Allabands Mill Stream, Almhouse Branch
St. Jones-	Lower St. Jones River

Tidbury Creek- Tidbury Creek, Red House Branch, Newell Branch, Voshell Pond, Derby Pond

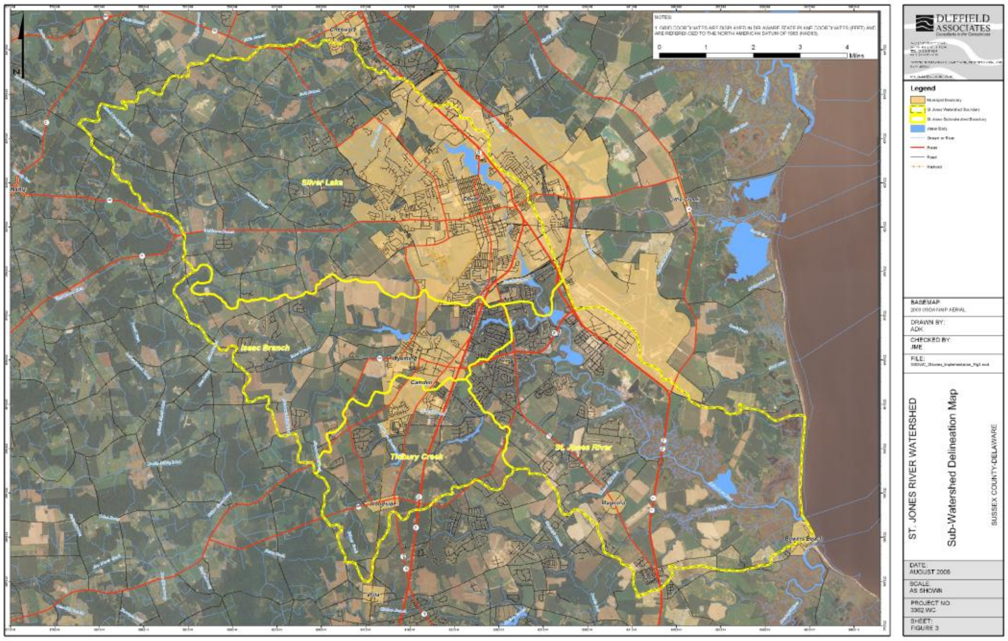


Figure 3. Sub-watersheds of the St. Jones River Watershed delineated.

EXECUTIVE SUMMARIES OF WATERSHED PROJECTS

SILVER LAKE SUB-WATERSHED

From its inception, the Silver Lake Commission (Commission) worked towards improving Silver Lake and its associated drainage area, the sub-watershed within the St. Jones Watershed. Through partnerships with state, county, local governments, and non-regulatory organizations, the Commission has completed numerous successful projects. It is also continuously adapting and improving projects to meet the challenges of difficult problems that arise in Silver Lake (Lake). The following lists identify past projects completed or attempted, and the background behind each project.

i. Silver Lake.

1. **Biological stimulant**. A new, proprietary product came recommended to DNREC staff by officials who used it to treat algal growth in stormwater ponds and water treatment facilities in California and Virginia. The product was designed to alter the nutrient ratios of carbon, nitrogen, and phosphorus, and encourage the growth of naturally occurring bacteria that is usually suppressed by overabundant algal blooms. At the time, algal blooms outcompeted natural bacteria for the available nutrients in the Lake. DNREC staff, alongside City of Dover personnel, decided to test this biological formula in Silver Lake and other smaller lakes and ponds in Delaware. It was applied to Silver Lake during the summer of 1996 every two weeks above the causeway. Ideally, the currents move some of the product below the causeway to improve algae conditions throughout the entire Lake. Using this method, the annual cost to the City is approximately $15,000. If an additional application needs to be applied below the causeway to achieve the desired results, the cost can increase to $25,000, plus the cost of additional supplies and personnel time.

   The results of the application of the biological stimulant were somewhat inconclusive. During the summer of 1996, above average rainfall events occurred in the area of Silver Lake. Silver Lake saw decreased amounts of algal blooms, however, it is uncertain whether that was a result of the stimulant, or the lake's higher, rain-induced flushing rates. City and DNREC staff had hoped to apply the stimulant the following summer to compare results between separate seasons; however, the company supplying the product had closed before the next round of testing could be completed (Tyler, 2011) (DNREC, City of Dover, and Advisory Committee, 1996).

2. **Aeration.** Aeration of Silver Lake was a recommendation from the report by F.X. Browne Associates and also in a discussion paper by DNREC, the City of Dover, Kent County, and an advisory committee, ("Options for the Protection and Improvement of Silver Lake") and was considered an option to increase the dissolved oxygen content of the Lake waters and enhance vertical circulation (DNREC, City of Dover, and Advisory Committee, 1996). Ideally, this would improve circulation of the water column, increase habitat for aerobic organisms, reduce or eliminate fish kills, reduce internal nutrient loadings, decrease blue-green algae populations, and improve water column oxygenation. This technique was described as being best suited for shallow lakes where temperature stratification is minimal. However, the costs associated with the amount of materials and equipment necessary for aerators to operate effectively in Silver Lake were high. There were also concerns regarding boat traffic in the lake and whether recreationalists using the lake would damage the aerators and associated components. Later, DNREC scientists advised against the use of aerators because of the determination that it would re-suspend phosphorus into the Lake (Tyler, 2011) (Edgell, 2011).

3. **Alum.** From the dismissal of the use of aerators grew the interest in using alum to alleviate the nutrient-related problems in the Lake. As suggested by the F.X. Browne report alum would bind phosphorus at the sediment-water interface and prohibit phosphorus from entering back into the water column (F.X. Browne, 1988). At the time, the technique was new and little was known about the lake characteristics needed for the process to be effective. Its use in coastal plain ecoregions, where shallow water ponds and lakes are common, is not feasible due to the short hydrologic residence time and sediment disturbance from physical and biological factors. Boating on the Lake is a popular activity and wave action from the boats would resuspend particulate phosphorus and particulate aluminum. Also, the expense to purchase alum alone is high (Greene, 2011).

ii. Silver Lake Sub-watershed

1. **Stormwater retrofit at Delaware State University.** In both the F.X. Browne study and "Options" report, recommendations for the creation of "forebays" at several inflow points into Silver Lake to try and trap sediment and other pollutants before washing into the Lake. One site where this was completed is located at the intersection of State College Road and N. College Road on the property of Delaware State University in Dover. The constructed forebay treats approximately 150 acres of commercial and industrial land, including 1.2 miles of the nearby 6-lane highway which is

one of the most traveled in the state. The project consists of a forebay area designed to capture the majority of the sediment and anything not captured there overflows to a shallow wetland area where additional water treatment can occur. In total, the project area is approximately 3 acres. Funds for the project came from partners including DNREC, City of Dover, Kent County, and Kent Conservation District. Additional monies came from DNREC penalty funds, 21st Century fund, and DelDOT pavement and rehabilitation funds (Division of Soil and Water Conservation).

2. **Dredging of Mirror Lake.** Mirror Lake is a shallow body of water downstream of the Silver Lake dam and adjacent to the intersection of Loockerman Street and Park Drive in Dover. The lake is tidally influenced by the St. Jones River and has a tidal range of approximately 1.0 foot. Over time a sand bar has developed from sediment build-up that is deposited and is visible at low tide. The City of Dover was interested in the improvement of Mirror Lake for environmental and aesthetic reasons and asked DNREC staff for recommendations. Staff from DNREC's Division of Soil and Water Conservation performed a bathymetric survey of the Lake in February 1997 and sediment core borings in September 2004 as a preliminary step to investigate the possibility of dredging to remove the accumulated sediment and other potential contaminants. DNREC provided two methods of dredging with cost estimates for each method. Mechanical dredging with truck haul disposal carried a price tag of approximately $427,500 and hydraulic dredging with geotubes had a cost of approximately $538,500 at the time of the estimation in 2007. Insufficient funds for the project halted any further progress for dredging Mirror Lake. DNREC revisited the topic again in 2010 by initiating a comprehensive analysis on the original sediment cores taken in 2004, preparing new cost estimates for dredging, of $1, 500,000, and speaking with the City of Dover and Silver Lake Commission about potential alternatives in preparation of the results of the analysis as the costs for dredging may be too high. DNREC also wishes to explore less expensive and invasive approaches to addressing the sediment sand bar, while maintaining the goal of reducing the impact to human and wildlife health.

Additional recommendations were made by F.X. Browne and the "Options" report, however only the items listed here have been acted upon thus far.

SUB-WATERSHED IMPLEMENTATION STRATEGY

STRATEGY

The Silver Lake Commission (Commission) re-evaluated their approach to solving Sliver Lake's water quality problems around 2005-2006, following their attempts at using large, solitary capital improvement project methods. Historically, the water quality problems facing the Lake were compounded due to many non-point sources discharging into the Lake untreated. The new approach focuses on a watershed-based method that addresses pollutant problems before they enter the Lake; in this way, pollutants are captured and filtered before they can degrade water quality in Silver Lake. This proactive approach encourages the completion of Best Management Practices (BMPs) throughout the watershed to alleviate the compounded effect in the Lake. While the BMPs may not capture all pollutants before entering the Lake, addressing the pollutants before they enter the Lake will significantly improve water quality.

To jumpstart the new watershed-based approach, DNREC hired Duffield Associates, Inc. (Duffield) to perform a watershed-wide assessment to identify water quality improvement projects. Duffield performed a baseline assessment in 2007 and published the "St. Jones River Watershed Baseline Assessment Technical Memorandum" (Baseline Assessment), in October 2008, which detailed the results. The information gathered provided the basis for future project recommendations and included information on Watershed and sub-watershed characteristics, as well as current and projected watershed conditions, to determine future issues and impairments. The Baseline Assessment identified potential pollution control opportunities by using information based on current reports, geospatial data, current regulations, and field review of actual stream bodies. During the field review, staff from DNREC, the Center for Watershed Protection (CWP), and Duffield documented visual cues and other watershed conditions that indicate potential water quality impairments such as: lack of riparian buffer area; undersized culverts downstream from development; point source discharge pollutant problems; older developments without stormwater quality best management practices; uncontrolled stormwater runoff - severe channel erosion; lack of infiltration basins; isolated wetland loss due to lack of regulations; and agricultural nutrient loading.

These impairments can be addressed and categorized into two categories "upland restoration" and Watershed Management Water Quality technologies (WMWQ), (Tyler, 2011) which include: tree planting; additional native landscaping; stormwater pond maintenance, creation, or bioretention; impervious cover removal; on-site stormwater management (e.g., rain barrels, rain gardens, green rooftops); creation/restoration of upland buffers; wetland/Floodplain Creation and/or Restoration; stormwater Infiltration; stream channel improvements; preservation of streams, wetlands, floodplains, and buffers; and flood control. In the St Jones Watershed, 26 WMWQ technology opportunities and 132 upland opportunities (total of 158 opportunities) were identified, screened, scored, and prioritized in the Implementation Plan as potential projects to improve water quality. The initial scoring and ranking of selected sites and technologies were conducted based on a system of weighted factors and scoring parameters established by the project team (DNREC, Duffield Associates, and CWP). For WMWQ sites, six technologies that focused on wetland/floodplain restoration and creation, buffers, infiltration, and preservation were evaluated for each site. The sites were then scored on a scale of 1 to 10 for potential, and ranked based on a watershed-wide scale, sub-watershed, technology-specific, and individual sites (Table 3). Upland sites were ranked into high, medium, or low priority based on screening factors and scoring criteria developed by the project team (Table 4). The list can be organized according to a certain target area, such as a sub-watershed (Table 5). The majority of pollution control opportunities throughout the entire watershed occur within the Silver Lake sub-watershed (Table 6).

As part of the final step in the watershed study of the St. Jones River basin, Duffield prepared "St. Jones Watershed Implementation Plan," in February 2009 to present strategies and potential prioritization to achieve the pollution control goals using the opportunities identified. The Plan examined several methods of implementation strategies for all of the sub-watersheds found in the overlying St. Jones Watershed (Watershed). This provides the option for different organizations, such as municipalities, DNREC, Kent County, or regional groups, to select the strategy that best suits their goals and priorities. The strategies were broken down into three approaches: ranking, technology, and sub-watershed. Duffield identifies the sub-watershed approach as the preferred strategy, citing targeted multi-faceted improvements can have significant impact on water quality improvement. A sub-watershed strategy is also conducive to various funding sources that may become available. As part of the Plan, Duffield recommends initiating the sub-watershed strategy with the Silver Lake sub-watershed, the largest in the entire Watershed.

Silver Lake sub-watershed almost fully encompasses the City of Dover, as well as the headwaters to the entire Watershed. Activities that take place in the headwaters of any watershed impact the overall health of the entire watershed. The Silver Lake sub-watershed is approximately 38.4 mi^2 (24,576 acres) and has the largest percentage of urban/commercial/residential area, approximately 31%, and the smallest portion of protected lands at 3.7% (Duffield Associates, Inc., February 2009). Projections for future impervious surface are expected to exceed all other sub-watersheds (Table 2, Introduction). These statistics support the recommendation to focus initial efforts in the Silver Lake sub-watershed. Additionally, Duffield found this sub-watershed to have the greatest potential for water quality improvement based on the number of high-ranking projects found in the field assessment. Duffield found the top five sites for WMWQ technology opportunities in the entire Watershed within the Silver Lake sub-watershed, as well as twelve upland sites with high ranks (Figure 4).

MONITORING

A monitoring plan helps determine the effectiveness of projects implemented throughout the watershed by measuring pollutant load reductions and water quality. It also important to track activities for state, federal, and municipalities reporting associated with water quality and restoration projects. In the Plan, Duffield outlines a monitoring plan with several important components for determining success. There are different methods presented in the Plan by Duffield to track progress based on the source of information. Timeframes associated with each method should also be considered when identifying appropriate monitoring techniques. It is important to determine an appropriate measure of success, preferably based on scientific data versus visual or aesthetic indicators, and educate members of the public in the same manner (Tyler, 2011). The Watershed should be reassessed on a regular basis (every 5-7 years) to maintain the most accurate data and determine if current priorities are inline with pre-established priorities. If new issues arise, refocusing the Watershed Plan may be necessary (Duffield Associates, Inc., February 2009).

Table 3. Silver Lake sub-watershed total WMWQ technology scores, ranked highest to lowest.

Screening Categories for WMWQ Technologies	SILVER LAKE SUB-WATERSHED SITE IDENTIFICATION NUMBERS																		
	12/13	**18**	**16**	**5**	**8**	**1**	**10**	**7**	**14**	**3**	**6**	**15**	**17**	**19**	**2**	**20**	**9**	**11**	**4**
Existing Buffer Width	1	4	1	10	4	2	10	4	1	1	1	1	1	1	2	1	7	0	1
Existing Buffer Length	3	3	6	10	6	3	9	6	3	7	3	3	3	3	3	3	4	3	6
Proposed Buffer Width	10	10	10	10	9	10	9	6	9	9	5	6	9	6	9	5	6	5	5
Areal Buffer Protection	10	10	10	10	10	10	10	8	10	10	8	10	10	10	8	10	10	10	8
Surrounding Topography Upgradient of Stream	4	3	4	4	4	3	4	3	4	3	4	4	4	4	4	4	4	4	4
Proposed Buffer Type	10	10	10	3	7	8	4	10	10	8	8	10	10	3	8	3	6	3	8
CREATION/RESTORATION OF UPLAND BUFFERS	**38**	**40**	**41**	**47**	**40**	**36**	**46**	**37**	**37**	**38**	**29**	**34**	**37**	**27**	**34**	**26**	**37**	**25**	**32**
Soil Types Within Creation and/or Restoration Areas	8	8	8	3	8	3	3	3	3	6	3	1	1	1	1	1	3	1	1
Approximate Average Depth of Excavation	9	10	10	7	9	7	7	8	4	1	4	6	3	4	1	4	4	1	1
Soil Relocation	10	10	10	10	10	10	10	9	10	9	9	10	10	10	9	10	5	10	4
Hydrology	9	9	10	9	9	9	7	9	5	2	5	5	5	5	0	5	7	2	2
Location Within Watershed	10	10	10	10	10	10	7	10	10	10	7	10	7	10	8	10	7	7	10

Wetland Type/Size	10	10	6	10	8	10	10	10	10	10	10	6	10	6	6	6	2	6	6
WETLAND/FLOODPLAIN CREATION AND/OR RESTORATION	**56**	**57**	**54**	**49**	**54**	**49**	**44**	**49**	**42**	**38**	**38**	**38**	**36**	**36**	**25**	**36**	**28**	**27**	**24**
Soil Types Within Creation Area	3	2	3	3	1	3	3	2	3	3	4	4	3	4	4	4	3	4	4
Appoximate Average Depth of Excavation	9	7	10	6	7	7	7	6	4	1	4	6	4	4	1	4	4	4	4
Soil Relocation	10	10	10	10	10	10	10	9	10	9	10	10	10	10	9	10	5	10	4
Permeability	6	6	6	6	6	7	6	6	7	7	7	7	7	7	7	7	6	7	7
Location Within Watershed	8	8	8	7	8	8	7	8	8	8	7	8	7	8	10	8	7	7	8
Size/Land Use	8	8	3	8	8	8	3	8	8	8	10	4	8	4	4	4	2	4	4
INFILTRATION	**44**	**41**	**40**	**40**	**40**	**43**	**36**	**39**	**40**	**36**	**42**	**39**	**39**	**37**	**35**	**37**	**27**	**36**	**31**
Access	7	9	7	7	4	7	9	7	7	7	9	7	6	7	7	7	9	7	7
Ownership	5	2	2	2	2	5	2	2	2	2	2	2	2	2	2	2	5	2	5
Likely Approach	7	7	7	7	7	5	7	7	7	7	7	7	7	7	7	7	3	5	3
Stream Length	6	6	4	10	6	8	6	4	6	8	4	6	6	6	8	6	6	6	2
Location Within Watershed	6	6	6	5	6	6	5	6	6	6	5	6	5	6	8	6	2	5	6
Level of Impairment	8	7	4	7	10	1	7	10	4	4	10	7	4	4	7	4	4	7	4
STREAM CHANNEL IMPROVEMENTS	**39**	**37**	**30**	**38**	**35**	**32**	**36**	**36**	**32**	**34**	**37**	**35**	**30**	**32**	**39**	**32**	**29**	**32**	**27**
Existing Preservation	10	10	10	7	7	7	7	7	10	7	7	10	3	10	7	10	7	7	7

Potential Disturbance Risk	10	7	7	5	5	8	5	5	7	8	5	7	0	7	5	7	8	5	5
Potential Preservation	10	4	5	5	4	4	4	5	4	4	4	4	0	4	5	4	5	4	5
Location Within Watershed	2	4	4	4	7	2	4	7	2	7	6	2	6	4	2	2	8	4	2
PRESERVATION OF STREAMS, WETLANDS & BUFFERS	**32**	**25**	**26**	**21**	**23**	**21**	**20**	**24**	**23**	**26**	**22**	**23**	**9**	**25**	**19**	**23**	**28**	**20**	**19**
Flood Storage Need	6	4	7	7	2	7	4	0	4	2	4	4	7	2	6	2	1	6	7
Storage Potential	3	3	2	4	3	4	3	2	3	1	3	1	3	2	3	2	1	2	1
Approximate Average Depth of Excavation	4	5	5	3	3	4	3	2	2	1	2	1	3	1	0	1	3	1	1
Location Within Watershed	5	5	5	3	5	5	3	1	5	5	3	5	3	5	4	5	2	3	4
FLOOD CONTROL	**18**	**17**	**19**	**17**	**13**	**20**	**13**	**5**	**14**	**9**	**12**	**11**	**16**	**10**	**13**	**10**	**7**	**12**	**13**
TOTAL SCORE	**227**	**217**	**210**	**212**	**205**	**201**	**195**	**190**	**188**	**181**	**180**	**180**	**167**	**167**	**165**	**164**	**156**	**152**	**146**

Table 4. Screening factors and scoring criteria for upland site evaluations.

Primary Screening Factor	Description	Scoring
Pounds of TN Removal Expected per Year	Combines total impervious area treated with removal efficiency of proposed retrofit. Will score the drainage area to the retrofit & removal efficiency of BMP	>11.5 lb = 30
		4.5 - 11.5 lb = 20
		1.5 - 4.5 lb = 10
		<1.5 lb = 0
Cost	Total retrofit cost	<15K = 25
		15 - 35K = 16
		35 - 95K = 8
		>95K = 0
Capture of off-site runoff	Whether any off-site runoff is captured and treated	Capture >= 0.25" during 0.5" storm event of off-site runoff = 10
		Capture >= 0.10" during 0.5" storm event of off-site runoff = 5
		No off-site runoff captured = 0
Runoff Reduction	Ability of practice to reduce overall volume of runoff through infiltration, absorption, runoff capture & reuse, etc.	Practice includes soil absorption (bioretention), infiltration, or retention = 20
		Practice includes filtering, runoff dispersion, or other practice that provides some runoff reduction = 10
		Practice does not include these features = 0
Short-term Implementation	Whether property has current funding, planning process underway where retrofit could fit into larger project, or located next to a sensitive water body (e.g., Silver Lake), 319 potential, dry pond conversion, DelDOT projects (less than 6 months)	Good chance for quick implementation = 15
		Potential chance for quick implementation = 7
		Not at this time = 0

Few Site & Utility Constraints	Retrofit Reconnaissance Inventory (RRI) does not identify utility conflicts at location of practice	No utility conflicts identified = 4
		Utility conflicts identified = 0
No Aesthetic, Nuisance, Safety Issues	Practice does not include standing water, mosquito habitat, steep drop-offs, unattractive nuisances, etc.	No issues identified = 1
		Issues identified = 0
Promotes innovative practices/LID	Practice promotes the concept of decentralized runoff treatment and reduction	LID promoted = 3
		LID not necessarily promoted = 0

		Scoring
		Exceptional opportunity = 3
		Moderate opportunity = 2
		Marginal opportunity = 1
		No opportunity = 0
Promotes Bacteria Removal	Practice contains filtering, desiccation, or other processes that can remove bacteria	Practice contains features = 2
		Practice doesn't contain features = 0
Supports Tree Canopy	Practice would result in NET gain in trees – trees	Trees planting included = 1

Table 5. Project ranking of Upland sites located in the Silver Lake sub-watershed.

Rank	Project ID	Sub-Watershed	Municipality	Name
High	R19c	Silver Lake	Dover	Dover High School
	R30a	Silver Lake	Dover	DE Agricultural Museum
	R48a	Silver Lake	Dover	Carroll's Corner Shop Cntr
	R31c	Silver Lake	Dover	Legislative Hall
	R41a	Silver Lake	Dover	Holy Cross
	R19e	Silver Lake	Dover	Dover High School
	R14c	Silver Lake	Dover	DE Tech & Comm College, Terry Campus
	R14d	Silver Lake	Dover	DE Tech & Comm College, Terry Campus
	R19b	Silver Lake	Dover	Dover High School
	R29c	Silver Lake	Dover	Fairview Elementary School
	R8a	Silver Lake	Dover	Super Fresh
	R34a	Silver Lake	Dover	Schutte Park
	N53	Silver Lake	Dover	Chatham Cove
	N56	Silver Lake	Dover	Silver Mill
	N49	Silver Lake	Dover	Capitol Green 1
	N78	Silver Lake		Rodney/ May/Cross/ Wedge
	N36	Silver Lake	Dover	Woodcrest
	N52	Silver Lake	Dover	Lake Club Apartments
	N77	Silver Lake	Dover	Woodbrook/Sherwood
	N38	Silver Lake	Dover	Fairview
	N55	Silver Lake	Dover	Overlook on Silver

				Lake
	N54	Silver Lake	Dover	East Lake Gardens
	N11	Silver Lake	Dover	Baltray
	N66	Silver Lake	none	Hunter's Pointe
	H505	Silver Lake	Dover	State Police Station/Museum
	H510	Silver Lake	Dover	Public Works Yard (P2)
	H506	Silver Lake	Dover	City Public Works Yard
	R13a	Silver Lake	Dover	Modern Maturity
	R26a	Silver Lake	Dover	Target
	R22a	Silver Lake	Dover	William Henry MS / Booker T Washington ES
	R8b	Silver Lake	Dover	Super Fresh
Med.	R19a	Silver Lake	Dover	Dover High School
	R26b	Silver Lake	Dover	Target
	R106a	Silver Lake	??	Taco Bell
	R502a	Silver Lake	Dover	Wawa
	R23a	Silver Lake	Dover	Dover Central Middle School
	R29a	Silver Lake	Dover	Fairview Elementary School
	R48b	Silver Lake	Dover	Carrolls Corner Shop. Cntr
	R64c	Silver Lake	Dover	Blue Hen Corporate Center
Med.	R201a	Silver Lake	Dover	Women's Health Center
	R530a	Silver Lake	Dover	Frear Federal Building
	R501a	Silver Lake	Dover	US Gas
	R64b	Silver Lake	Dover	Blue Hen Corporate

			Center
R101a	Silver Lake	Dover	City Hall
R13b	Silver Lake	Dover	Modern Maturity
R25b	Silver Lake	Dover	Edgehill Shopping Center/State Library
R41c	Silver Lake	Dover	Holy Cross
R64a	Silver Lake	Dover	Blue Hen Corporate Center
R108a	Silver Lake	Dover	La Tonalteca
R505b	Silver Lake	Dover	State Police Museum
R31b	Silver Lake	Dover	Legislative Hall
R500a	Silver Lake	Dover	St Andrews Lutheran Church
R25c	Silver Lake	Dover	Edgehill Shopping Center/State Library
R105a	Silver Lake	Dover	Burger King
R510a	Silver Lake	Dover	Harvest House
R26c	Silver Lake	Dover	Target
R505a	Silver Lake	Dover	State Police Museum
R31a	Silver Lake	Dover	Legislative Hall
R48c	Silver Lake	Dover	Carrolls Corner Shopping Center
R41b	Silver Lake	Dover	Holy Cross
R16c	Silver Lake	Dover	McKee Business Park
R102a	Silver Lake	Dover	Merrill Lynch
R42a	Silver Lake	Dover	South Dover Elementary School
R43a	Silver Lake	Dover	Bay Court Plaza
N1	Silver Lake	Dover	Mill Creek

	N50	Silver Lake	Dover	Capitol Green 2
	N51	Silver Lake	Dover	Edgehill/Dover Heights
	N114	Silver Lake	none	Capitol Park
	N173	Silver Lake	none	Quails Nest
	N4	Silver Lake	Dover	Maple Dale Retreat
	N202	Silver Lake	None	Meadow Ridge
	N3	Silver Lake	Dover	The Meadows
	N60	Silver Lake	none	Carlisle Village
	N47	Silver Lake	Dover	Elm Terrace & State St
	N48	Silver Lake	Dover	Kent Ave
	N39	Silver Lake	Dover	Division St & Governors
	N63	Silver Lake	None	Foxhall
	H501	Silver Lake	Dover	US Gas
	H504	Silver Lake	none	Cheswold Recycle Center
	H502	Silver Lake	Dover	Wawa
Low	R14a	Silver Lake	Dover	DE Tech & Comm College, Terry Campus
	R107a	Silver Lake	Dover	Del Taco
	R4a	Silver Lake	Dover	Kmart
	R10a	Silver Lake	Dover	Golden Corral
	R20a	Silver Lake	Dover	Proctor & Gamble North Building
	R27a	Silver Lake	Dover	Dover Mart
	R14b	Silver Lake	Dover	DE Tech & Comm College, Terry Campus
	R21a	Silver Lake	Dover	Proctor & Gamble South Building

	R19d	Silver Lake	Dover	Dover High School
	R200a	Silver Lake	none	A & H Uniform
	R501b	Silver Lake	Dover	US Gas
	N2	Silver Lake	Dover	Maple Glen Dr
	N21	Silver Lake	none	Zurkow Lots
	N69	Silver Lake	None	Rt 8 & Sharon Hill Rd
	H301	Silver Lake	Dover	Gas Station/U-Haul
	H303	Silver Lake	Dover	Car Zone
	H503	Silver Lake	none	Poors Energy Service
	H507	Silver Lake	Dover	Jiffy Lube
	H508	Silver Lake	Dover	Edgehill Shopping Center
	H500	Silver Lake	Dover	Auto Zone
	H509	Silver Lake	Dover	Self Wash/Wax

*Property owners have not been contacted as part of the preparation of this report.

Sub-Watershed Key
St. Jones
Tidbury Creek
Isaac Branch
Silver Lake

Table 6. Watershed wide WMWQ scores ranked highest to lowest (Duffield 2008).

Screening Categories for WMWQ Technologies	SITE IDENTIFICATION NUMBERS																								
	12/13	**18**	**16**	**5**	**8**	**27**	**1**	**10**	**7**	**14**	**26**	**23**	**3**	**6**	**15**	**21**	**22**	**25**	**17**	**19**	**2**	**20**	**9**	**24**	**11**	**4**
CREATION/RESTORATION OF UPLAND BUFFERS	38	40	41	47	40	38	36	46	37	37	37	40	38	29	34	27	28	33	37	27	34	26	37	28	25	32
WETLAND/FLOODPLAIN CREATION AND/OR RESTORATION	56	57	54	49	54	39	49	44	49	42	37	34	38	38	38	38	38	32	36	36	25	36	28	38	27	24
INFILTRATION	44	41	40	40	40	42	43	36	39	40	43	40	36	42	39	40	40	39	39	37	35	37	27	29	36	31
STREAM CHANNEL IMPROVEMENTS	39	37	30	38	35	33	32	36	36	32	31	33	34	37	35	31	31	31	30	32	39	32	29	22	32	27
PRESERVATION OF STREAMS, WETLANDS & BUFFERS	32	25	26	21	23	32	21	20	24	23	24	30	26	22	23	32	26	26	9	25	19	23	28	25	20	19
FLOOD CONTROL	18	17	19	17	13	19	20	13	5	14	14	6	9	12	11	6	10	12	16	10	13	10	7	13	12	13
TOTAL SCORE	227	217	210	212	205	203	201	195	190	188	186	183	181	180	180	174	173	173	167	167	165	164	156	155	152	146

*** Property owners have not been contacted as part of the preparation for this report. Red numbers are highest technology scores.**

Sub-Watershed Key
St. Jones
Tidbury Creek
Isaac Branch
Silver Lake

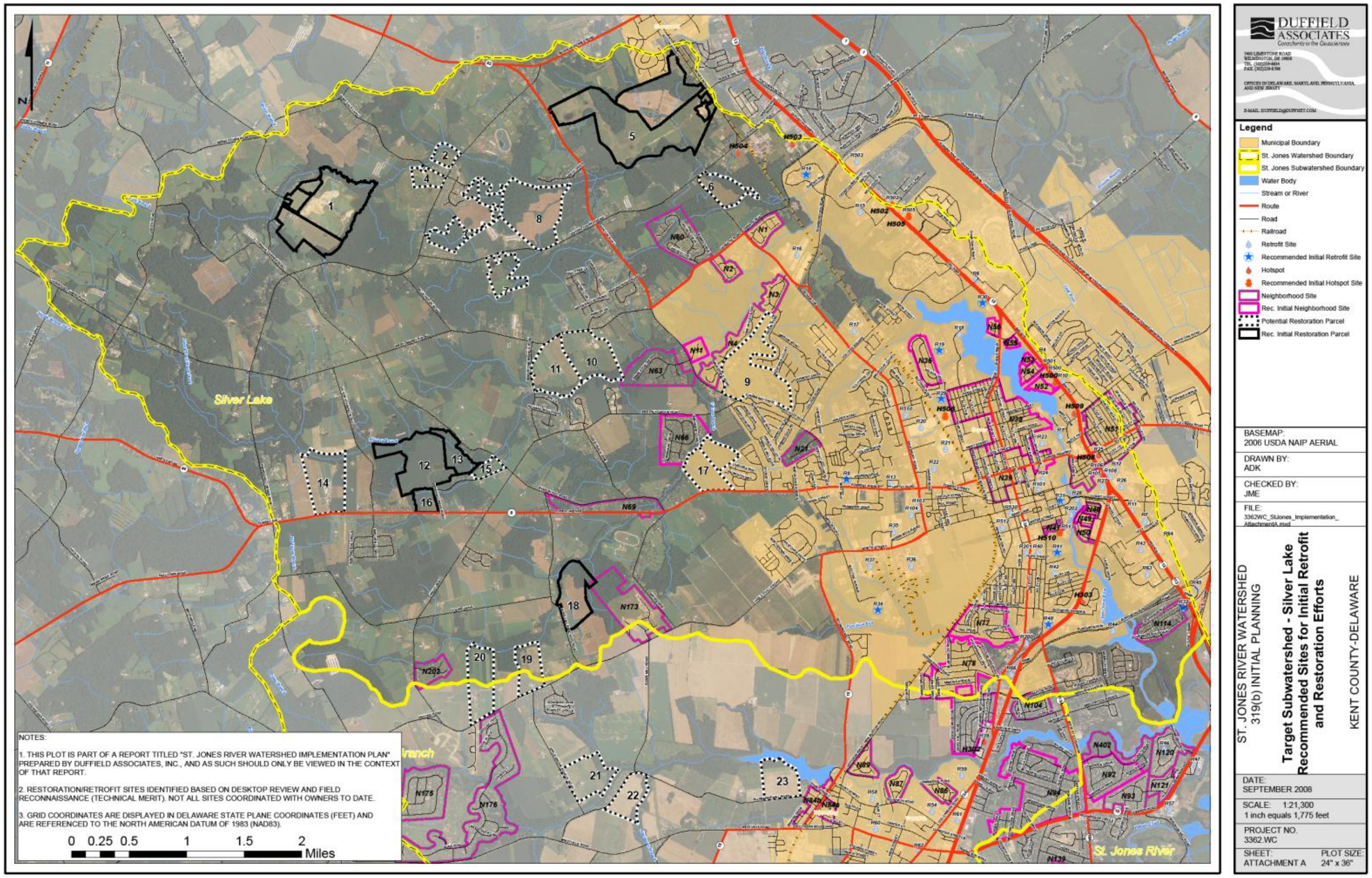


Figure 4. Initial recommendation sites for the Silver Lake sub-watershed (Duffield 2008).

SUB-WATERSHED MANAGEMENT OPPORTUNITIES

INTRODUCTION

With a strategy in place, partners and other organizations have a more focused approach to improving the quality of the St. Jones Watershed. The Silver Lake sub-watershed strategy may not fulfill the priorities of every organization and may be limiting for those with specific objectives. However, the strategy provides direction for future management opportunities. As part of the "St. Jones Watershed Implementation Plan" (Plan) by Duffield , priority lists were developed to target pollution control opportunities within the Silver Lake sub-watershed. These lists use different strategies such as upland sites, Watershed Management for Water Quality (WMWQ) technologies, neighborhoods, hotspots, and preservation to identify target projects. The lists developed by the Plan are a place to begin efforts. It is not meant to be implemented strictly in chronological order, but instead used as a guide for watershed improvement activities that ultimately depend on partner cooperation and funding availability.

The lists below provide an overview of the current efforts occurring in the Silver Lake sub-watershed to improve water quality. These projects, identified either before or recently after the Plan was written, were chosen based on landowner and partner cooperation and willingness to collaborate on the proposed improvement projects. The site name and identification code are listed next to those sites identified in the Plan's list of potential upland sites. The Plan provides useful cost estimates of Best Management Practices (BMP) identified for individual upland projects that may help with decisions with budgets. Another useful tool is the expected pollutant removal by each BMP and the associated costs, therefore providing the cost effectiveness of each project. Common storm water BMP and their associated nutrient removal rate are presented in Table 7.

WMWQ technologies are also listed in the Plan and show a great deal of potential. The WMWQ technologies are a reflection of the specific types of pollution control measures identified by the St Jones Tributary Action Team (TAT) in the Pollution Control Strategy (PCS Addendum 1) to improve water quality within the watershed. These projects are typically larger scale and require more land area, space, and most importantly, participation from private landowners. The benefits, however, are just as successful as upland/urban retrofits as they occur mostly in the headwaters of the Watershed and sub-watersheds. Planners and land managers should reference this strategy and the Plan for guidance on future project planning.

Table 7. BMP Percent Reduction of Nutrients from Urban Runoff

BMP	Total Nitrogen (%)	Total Phosphorous (%)
Stormwater Wet Ponds	40	50
Sand Filter	47	41
Stormwater Dry Ponds	15	25
Stormwater Wetlands	30	49
Infiltration Practices	65	70
Water Quality Swales	25	34
Rain Garden	43	81

SILVER LAKE SUB-WATERSHED PROJECTS

CURRENT PROJECTS

1. Dover High School. Located at Walker Road and Patrick Lynn Drive in Dover, DE, the high school campus would benefit from better stormwater infiltration practices. URS Corp. has submitted a proposal for design and conceptual work for the site. Several ideas were proposed, and after site visits, design consultations, and meetings with school personnel, the following projects were designated as the best options:

    - construction of a rain garden to collect stormwater runoff from the parking lot surface;
    - restoring function and prevent erosion to the discharge area in the unnamed channel;
    - increasing water volume entering the wetland/storage area in the existing stormwater wetland to improve nutrient removal.

    The rain garden alone will prevent 5 pounds of nitrogen, 0.5 pound each of phosphorus and zinc, and 275 lbs of sediment per year from entering Silver Lake. The pollutant load reduction for the stormwater wetland retrofit is yet to be determined, but should be comparable to the previous reductions, if not more. Reference in Duffield: Site Name: R19 – Dover High School.


2. Delaware Agricultural Museum and Village. Located off of Rt. 13 southbound in Dover, DE, the Agricultural Museum and Village (Museum) property was identified in the Duffield report for a conversion of a dry pond to a bioswale. The dry pond conversion, in addition to other enhancements, has recently been completed with funds primarily from the Clean Water Advisory Council's Community grant. Plans to convert it to a bioswale and re-grade adjacent land to direct water flow away from Museum buildings and towards the bioswale have recently been completed. Two rain gardens, on either side of the Museum entrance, collect almost half of the stormwater runoff from the roof where it previously was discharged onto mowed grass. Additionally, a 10-foot buffer encircling three sides of Mill pond was planted to discourage Canada geese from nesting and traversing between the pond and land. Six floating wetlands, a new technique used to improve the water quality, were launched in Mill pond. Water samples were collected to monitor the effect floating wetlands had on phosphorus, nitrogen, and bacteria removal. Fencing was installed along the Silver Lake shoreline on Museum property to reduce the number of geese entering the property via Silver Lake. The bioswale is estimated to remove 1 pound each of phosphorus and zinc, 7.5 pounds of nitrogen, and 500 pounds of sediment per year. Each rain garden is estimated to reduce phosphorus and nitrogen by 45%, zinc by 80% and sediment by 60%. The removal of nutrients and bacteria from the Mill pond due to the floating wetlands and vegetated buffer are still being monitored through water sample analyses, but are expected to reduce bacteria significantly. Reference in Duffield: Site Name: R30 – DE Agricultural Museum.



3. Delaware Technical and Community College. Located at Scarborough Road and Route 13 in Dover, DE. The Technical and Community College's campus offers an opportunity to work with students and officials to create a stormwater management and sustainability plan that will address the College's future needs of expansion while maintaining and enhancing stormwater infiltration and bioretention practices. Cost estimates are currently being determined for potential projects including: several rain gardens, converting a tax ditch to a bioswale, step pool conversion, and re-grading areas to collect more water for treatment before entering the storm drain system untreated. All project combined would remove approximately 4.25 pounds of phosphorus, 37 pounds of nitrogen, 3.6 pounds of zinc, and 3,502 pounds of sediment per year from entering Silver Lake. Reference in Duffield: Site Name: R14 - DE Technical & Community College, Terry Campus.

4. Fairview Elementary School. Located at the intersection of Walker Rd and Pear St in Dover, DE. The principal at Fairview Elementary school has agreed to disconnect several downspouts to construct a large rain garden near the building where students and faculty pass by regularly. Education on rain gardens and stormwater runoff will be incorporated into lesson plans and will continue even after construction ends. In addition, the rain gardens will remove 0.5 pound of phosphorus, 3.75 pounds of nitrogen, 0.5 pound of zinc, and 250 pounds of sediment per year from stormwater runoff. Reference in Duffield: Site Name: R29 – Fairview Elementary.

5. Silver Lake Park. Located adjacent and south of the Silver Lake dam with parking off of Washington Street and Lewis Mill Drive in Dover, DE. As part of a cooperative effort amongst DNREC's Watershed Assessment Section, 319 Nonpoint Source Program, Division of Parks and Recreation, DELDOT's Environmental Program, City of Dover's

Silver Lake Commission, and Polytech High School the Silver Lake Park Revitalization Plan was developed to improve water quality in the St. Jones River while improving the aesthetic value of the river to Dover residents and park visitors. Comments from Dover residents and members of the public were incorporated as much as possible to ensure the park would still serve the needs of its primary stakeholders. Several key projects were identified and broken down into four implementation phases (Figure 5). Each phase included a plan to establish riparian buffer along the river in a tiered system that incorporates grasses and trees and can reduce sediments up to 96%, nitrogen up to 95% and phosphorus up to 79% (www.nrcs.usda.gov/NRCSProg.html). Phase 1 of the Revitalization Plan is almost complete with the northern portion's riparian buffer complete, but still lacking park benches and educational and interpretive signage. The southern portion of Phase 1 is currently on hold until other phases are closer to completion. DNREC hired Biohabitats Inc. to develop the design of Phase 2, including the discharge received by Washington Street in the drainage ditch adjacent to the park that empties to the St. Jones River. After extensive surveying and planning, Biohabitats created several options to choose from for the stabilization and restoration of the St. Jones River near the dam. Shortly after, a public meeting was held in conjunction with DNREC, City of Dover, Silver Lake Commission and Biohabitats to determine the final design based on public input received during the meeting. The figure below is a detailed sketch of the proposed design of the work to be done along the east side of the River and park. The Mill Race, or wetland slough as identified in the sketch below, was added later to address the excessively wet "island" area (Figure 6). During field review, the required permitting agencies determined the design would need to be revised slightly to meet state and federal standards. Permits for this project were received at the end of February 2011 and bidding for construction is currently underway. Design plans are currently being completed for Phase 3 in conjunction with partners from the City of Dover and Kent County Parks & Recreation and will be planted in the Fall 2011. Portions of Phase 4 have been completed with help from the City of Dover, Kent County Parks & Recreation, Elizabeth Murphey School, and Central Middle School (see "Partner Projects" listed below for more information). Other projects are in development and will address storm water runoff and connect the riparian corridor (see DNREC Richards & Robinson's property, Figure 7).

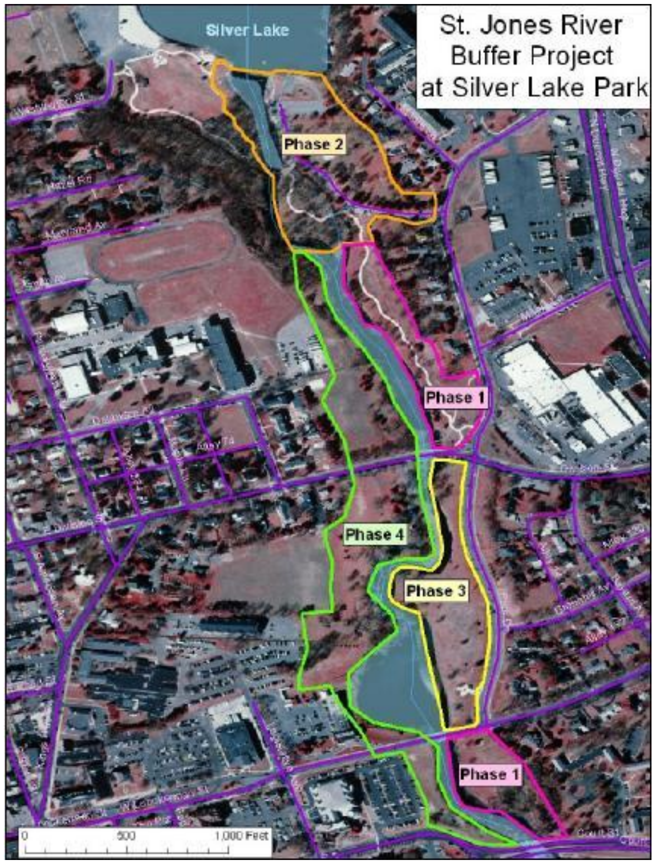


Figure 5. Silver Lake Park Revitalization Plan with Phases 1-4 identified.

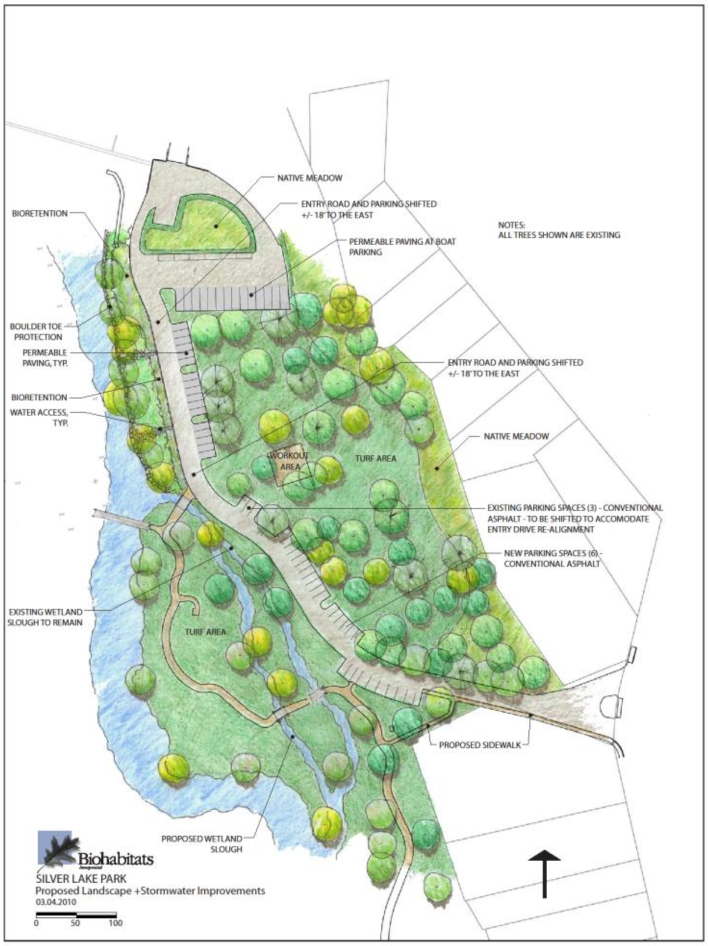


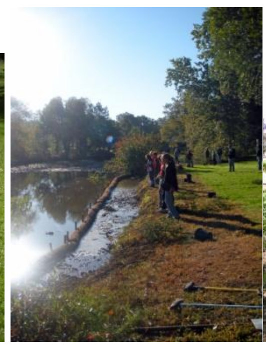
Figure 6. Biohabitats rendition of the proposed restoration and stabilization along the St. Jones River.

6. Washington Street. Storm water runoff exiting from Washington Street in Dover, DE, the entrance road to the beach side of Silver Lake Park, is currently discharging untreated directly into the St. Jones River. Plans for a regenerative step pool conveyance system are currently under way and should be completed in conjunction with Phase 2 of the Silver Lake Park Revitalization Plan. The step pool system is projected to reduce Nitrogen and Phosphorus by 45% and sediment by 60% from the stormwater that currently drains from the approximately 17 acres of adjacent land. Using a common loading rate for the Dover area, reductions using this technology for the said acreage of land are estimated to remove 121.7 pounds of Nitrogen, 16.5 pounds of Phosphorus, and 8500 pounds of sediment per year.

7. DNREC Richards & Robinson's property. Located in downtown Dover, DE at 89 Kings Highway. Storm water runoff from this parcel is currently draining to Mirror Lake untreated. As part of DNREC's environmental improvement plan, storm water runoff will be directed through a series of storm water BMP's while an increase in riparian buffer width will also help remove pollutants from entering Mirror Lake. This plan will also attempt to address the sediment bar and associated contaminants found in Mirror Lake at low tide. Residents and scientists will work together to develop a solution. See "Mirror Lake: Analysis of Chemical Contaminants in Sediments," 2011 and the DNREC "Environmental Improvement Plans for Selected DNREC Office Sites," 2011 for more detailed information.

Figure 7. DNREC Richardson & Robbins property and the proposed environmental improvements adjacent to the St. Jones River

8. Elizabeth Murphey School. Located on the north side of East Division Street and west of the St. Jones River in Dover, DE. This area is located directly across from the riparian buffer planted in Phase 1 of the Silver Lake Park Revitalization Plan. The low-lying land adjacent to the river was being mowed all the way to the edge of the river and experienced frequent ponding or flooding during heavy rainfall. The shoreline was severely eroded from human and animal traffic as well as water velocity in the river. In the spring and fall of 2010, partners from Kent County Parks and Recreation, City of Dover, and DNREC established a tiered riparian buffer and approximately 120 linear feet of "living shoreline" consisting of biocoir logs and vegetating the backfilled soil medium.


9. Central Middle School. Located on the north side of East Division Street and the Elizabeth Murphey School and west of the St. Jones River in Dover, DE. The area surrounding part of the St. Jones River that flows from the dam on the south side of Silver Lake (Park) to the intersection of Loockerman Street at Mirror Lake is a widely used area. Currently, the grassed area between the school and the River is mowed almost directly to the bank. The partial wooded area of the project has extensive areas of invasive species (Japanese honeysuckle, English ivy, Phragmites, Virginai creeper, Trumpet Crepper, Porcelain berry, Autumn Olive, tree of Heaven, Multiflora rose, and Privet). The invasive plants will be removed and sprayed with the help Delaware Division of Parks and Recreation before the buffer is planted with native species. In addition, an outdoor classroom will be created using recycled tire (semi-permeable) flooring area creating a seating/classroom area. Students, in accordance with 7th grade science curriculum, will test water quality annually in order to determine the health of our local Silver Lake/St. Jones watershed. Additionally, students will use digital photography to meet further Science standards. A tiered riparian buffer system, which incorporates grasses and trees, can reduce sediments up to 96%, nitrogen up to 95% and phosphorus up to 79%.

10. Natural Resource Conservation Service (NRCS) building. Located off of College Park Drive in Dover, DE. In 2010, partners from the Partnership for the Delaware Estuary, NRCS, and Environmental Concern designed and installed a rain garden to collect runoff from the adjacent parking lot and roof. Using help from students of North Dover Elementary school, the rain garden was planted with 600 native plants to treat storm water runoff before it enters the river system untreated.

11. Silver Lake Dam stabilization. The City of Dover's Emergency Management Division complied with the insurance agency overseeing the Silver Lake dam by making necessary improvements. These improvements included vegetating either side of the dam's northern portion and fencing it off to prevent damage from waterfowl of park visitors. Large rip rap was also installed to reduce the any additional erosion along the banks due to wave action, foot traffic, and wildlife use. As a result, these improvements will discourage foot traffic to vulnerable areas and improve the safety and environmental integrity of the structure and surrounding area.

ii. <u>Education and Outreach</u>

i) Rain Gardens for the Bays. EPA Region 3 initiative to reduce storm water runoff entering "our bays" including the Delaware Bay, Delaware's Inland Bays, and Maryland's Coastal Bays by installing rain gardens in the Bays' watersheds. To date, three rain gardens exist in the St. Jones Watershed, including 2 at the Delaware Agricultural Museum, 1 at the Natural Resource Conservation Services (NRCS) office off of College Park Dr. and 1 at Fairview Elementary School with assistance from the Partnership for the Delaware Estuary.

ii) Fertilizer Campaign. Marketed as "Livable Lawns," this campaign targets landscaping companies and homeowners that apply fertilizer to lawns. The campaign aims to educate homeowners and landscape professionals about the consequences of excessive fertilizer use and fertilizer alternatives while ultimately reducing the amount of excess nutrients reaching Delaware waterways.

FUTURE OUTLOOK OF THE SILVER LAKE SUB-WATERSHED

The St. Jones Tributary Action Team (TAT) developed recommendations to reduce non-point source nutrient and bacteria loads to the St. Jones Watershed in order to meet the 2006 Total Maximum Daily Load (TMDL) as established by the Environmental Protection Agency (EPA). Through extensive education and discussion, the St. Jones TAT developed recommendations for open space, stormwater, wastewater, agriculture, and education. These recommendations were submitted in the form of a Pollution Control Strategy (PCS) to then-Secretary of DNREC, John Hughes. The St. Jones PCS is currently being finalized and will be submitted to EPA shortly thereafter. The document is an excellent resource for a citizen perspective of important issues related to improving the water quality of the St. Jones Watershed.

Within the storm water section of the St. Jones PCS, the TAT recommends implementing a storm water utility to generate a stable source of funding for storm water management throughout the watershed. Governor Minner's Task Force on Surface Water Management quantified the statewide financial need for stormwater management. "The Finance Subcommittee identified stormwater capital requirements of $207.3 million over the next five years and projected annual maintenance requirements of $13.73 million” (URS Corporation, 2009). The Task Force thus recommended that a stormwater utility operating at the county or local level should be formed as a funding vehicle for the purpose of providing a simplified and comprehensive approach to drainage and flooding problems. A stormwater utility is an approach that can generate a stable source of funding for stormwater management within the region. The funds are made available by collecting user fees. Stormwater utility fees are generally set by the amount of impervious cover on each resident’s property. The higher the impervious cover the higher the fee. GIS mapping will be utilized to measure impervious surface generated by residential and commercial development, and the utility fee will be charged based on the property’s Equivalent Residential Unit (ERU). In fall 2011, members of the City of Dover’s Council will be invited to participate in a tour of existing stormwater structures throughout the City and entire Watershed to examine the costs associated with maintaining quality facilities.

There are many benefits of a stormwater utility. According to DNREC, Division of Watershed Stewardship, Watershed Assessment Section, a stormwater utility can generate up to $10 per capita per $1/month/ERU. It is estimated that approximately one-eighth to one-sixth of the annual revenue from a $1/month/ERU stormwater utility results in approximately $30,000--$40,000 for cities and approximately $180,000--$250,000 for counties (Christina Tributary Action Team and Water Resources Agency, 2007). The revenue generated from the utility can be used to fund a variety of stormwater management and water quality programs. This tool can be used in the St. Jones Watershed to contribute to the reduction of nutrients and bacteria reaching the rivers and streams by implementing best management practices with the funds generated from the stormwater utility.

Efficient implementation of best management practices and water quality improvement projects depend largely on staff resources. It is suggested that the stormwater utility be used to fund a staff position/Watershed Coordinator dedicated to managing and implementing the projects throughout the St. Jones Watershed. New projects will require researching appropriate funding and attention to detail during design and engineering phases. Stable funding for a Watershed Coordinator becomes more important when completing multi-phased or long-term projects. Also, creating an established position will allow the Watershed Coordinator to create and maintain local contacts, thereby generating support and resources for future projects.

The Sediment and Stormwater regulations serve as an enabling structure for the local ordinances needed in order to set up the utility. For example, the City of Wilmington has established a stormwater utility for residential and commercial customers in the municipality where all properties pay a stormwater charge based on their impervious cover.

Before funding even becomes available, potential projects should already be identified in a priority list. Once funding does become available the process will move much quicker and smoother if all research and cost-estimates are completed ahead of time. During the course of current project implementation by the St. Jones Watershed Coordinator and partners, a list of potential projects have surfaced through both the Plan and amicable partnerships developed with landowners, businesses, and partners. The following are projects currently being researched for further potential as a stormwater improvement project:

Site	*Location*	*Description of project*	*Landscape position*	*Duffield priority*
Super Fresh	Dover, Silver Lake Sub-watershed	Convert existing dry pond to large, passive bioretention.	Headwaters	High
Modern Maturity Center	Dover, Silver Lake Sub-watershed	Convert dry pond to bioretention	Headwaters	Medium
Behind Dover Pools & Ag Museum	Dover, Silver Lake Sub-watershed	Regenerative stormwater conveyance system	Adjacent to Lake	Unlisted *
Winding Creek DE, LLC	Dover, Silver Lake Sub-watershed	Potential for wetland/floodplain creation and/or restoration, stormwater infiltration, stream channel improvements, preservation, and flood control.	Headwaters; confluence of Maidstone & Penrose Branches	Duffield WMWQ Project # 12/13
Private Landowner	Dover, Silver Lake Sub-watershed	Potential for wetland/floodplain creation and/or restoration, stormwater infiltration, stream channel improvements, and flood control.	Headwaters; adjacent to Cahoon Branch	Duffield WMWQ Project # 18

***** Untreated stormwater discharge into Silver Lake behind Delaware Agricultural Museum & Village and Dover Pools. Identified while completing BMPs on the Ag Museum property. Developed a positive relationship with staff at the Ag Museum.

Outside funding sources may help supplement or extend the life of funds generated by the stormwater utility. Partnering with other organizations (state, county, and municipal agencies, non-profits, etc.) help leverage funds and promote productive and successful partnerships. Funding sources used in the past include: Delaware's Clean Water Advisory Council's Community

Water Quality Improvement Grant, 319 Non-Point Source grant, Delaware Land and Water Conservation Trust Fund Trail Grant, and Community Environmental Project Fund (penalty funds). New funding sources may arise and should be explored. Also, some funding sources are better suited for certain projects than others. It is important to apply for the grant that most appropriately fits the objectives and goals of each project.

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